

## CLAIMS:

1. Apparatus for navigating an instrument through an anatomical structure of a patient's body volume, comprising a table for supporting the patient and at least a first C-arm having a first X-ray source and a first X-ray detector for acquiring a first series of 2D-images of the instrument whilst manoeuvring through said anatomical structure, and further  
5 comprising a processing unit for the images which unit connects to a memory device, whereby the memory device function is to hold pre-determined 3D-images of the patient's anatomical structure, and the processing unit is arranged for processing the 2D-images of the instrument and the 3D-images of the anatomical structure so as to provide merged 3D-images of the instrument that in use manoeuvres through said anatomical structure, characterized in  
10 that, the processing unit is arranged to carry out a 2D-3D registration to relate the coordinates of the 2D-images of the instrument to the coordinates of the 3D-images of the anatomical structure prior to providing the merged 3D-images of the instrument and the anatomical structure.
- 15 2. Apparatus according to claim 1, characterized in that, it comprises a second C-arm with a second X-ray source and a second X-ray detector for acquiring a second series of 2D-images simultaneously with the first series of 2D-images, and that the processing unit is arranged to carry out the 2D-3D registration on both the first series and the second series of 2D-images of the instrument, and that the processing unit is arranged to derive thereafter a  
20 3D-image of the instrument based on said first and second series of 2D-images, and to merge said 3D-image of the instrument with the 3D-images of the anatomical structure.
3. Apparatus according to claim 1, characterized in that the memory device holds a pre-determined 3D-model representation of the instrument and that the processing unit is  
25 arranged to carry out a 2D-3D registration to relate the coordinates of the 3D-model representation with the coordinates of the 2D-images of the instrument, and that the processing unit is further arranged to calculate 2D-model images of the instrument corresponding to the acquired 2D-images of the instrument, and to modify the 3D-model representation into an adapted 3D-model representation in order to optimize matching of the

2D-model images to the acquired 2D-images of the instrument, and that the processing unit is further arranged to merge the adapted 3D-model representation of the instrument with the 3D-images of the anatomical structure.

5     4.             Apparatus according to claim 3, characterized in that it comprises a second C-arm with a second X-ray source and a second X-ray detector for acquiring a second series of 2D-images simultaneously with the first series of 2D-images, and that the processing unit is arranged to carry out the registration of the coordinates of the 3D-model representation in respect of both the first series and the second series of 2D-images of the instrument, and that  
10   the processing unit is arranged to derive thereafter an adapted 3D-model representation of the instrument based on both the first series and the second series of 2D-images of the instrument, and to merge this adapted 3D-model representation with the 3D-images of the anatomical structure.

15   5.             Method for navigating an instrument through a anatomical structure of a patient's body volume comprising the steps of  
- having available 3D-images of the patient's anatomical structure  
- acquiring a first series of 2D-images of the instrument whilst manoeuvring through the anatomical structure  
20   - processing the 2D-images of the instrument and the 3D-images of the anatomical structure for providing merged 3D-images of the instrument manoeuvring through the anatomical structure characterized in that, the 2D-images of the instrument are registered with the 3D-images of the anatomical structure prior to providing the merged 3D-images of the instrument and the anatomical structure.

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6.             Method according to claim 5, characterized in that, a second series of 2D-images is acquired simultaneously with the first series of 2D-images of the instrument but from a different angle, that both the first series and the second series of 2D-images of the instrument are registered with the 3D-images of the anatomical structure followed by  
30   deriving from the first and second series of 2D-images a series of 3D-images of the instrument, and that the 3D-images of the instrument are merged with the 3D-images of the anatomical structure.

7. Method according to claim 5, characterized in that a 3D-model representation of the instrument is acquired and is registered with the 2D-images of the instrument, and in that 2D-model images of the instrument are derived from said 3D-model representation corresponding to the acquired 2D-images of the instrument, and that said 3D-model representation is adapted to optimize the matching of the 2D-model images with the acquired images of the instrument prior to merging the adapted 3D-model representation of the instrument with the 3D anatomical structure.
8. Method according to claim 7, characterized in that a second series of 2D-images is acquired simultaneously with the first series of 2D-images of the instrument but from a different angle, and that a registration is carried out of the coordinates of the 3D-model representation of the instrument in respect of both the first series and the second series of 2D-images of the instrument, whereafter the 3D-model representation of the instrument is adapted to optimize the matching of said first series and second series of images of the instrument with 2D-model images of the instrument derived from said 3D-model representation, and that thereafter the adapted 3D-model representation of the instrument is merged with the 3D anatomical structure.
9. Software for a computer in an apparatus for navigating an instrument through an anatomical structure of a patient's body volume, which apparatus is arranged to implement the steps of:
- accessing 3D-images of the patient's anatomical structure
  - acquiring a first series of 2D-images of the instrument whilst manoeuvring through the anatomical structure, wherein execution of the software causes the computer to
  - process the 2D-images of the instrument and the 3D-images of the anatomical structure for providing merged 3D-images of the instrument manoeuvring through the anatomical structure characterized in that, executing said software causes the computer to register the 2D-images of the instrument with the 3D-images of the anatomical structure prior to providing the merged 3D-images of the instrument and the anatomical structure.
10. Software according to claim 9, arranged for processing a first series of 2D-images and a second series of 2D-images of the instrument, that are acquired simultaneously but from different angles, characterized in that executing the software causes the computer to register both the first series and the second series of 2D-images of the instrument with the

3D-images of the anatomical structure, and thereafter to derive from the first and the second series of 2D-images a series of 3D-images of the instrument, and to merge the 3D-images of the instrument with the 3D-images of the anatomical structure.

5 11. Software according to claim 9, characterized in that execution thereof causes the computer to register an acquired 3D-model representation of the instrument with the 2D-images of the instrument, to derive 2D-model images of the instrument from said 3D-model representation corresponding to the acquired 2D-images of the instrument, and to adapt said 3D-model representation in order to optimize the matching of the 2D-model images with the  
10 acquired images of the instrument prior to merging the adapted 3D-model representation of the instrument with the 3D anatomical structure.

12. Software according to claim 11, arranged for processing a first series of 2D-images and a second series of 2D-images of the instrument that are acquired simultaneously,  
15 but from a different angle, characterized in that execution thereof causes the computer to carry out a registration of the coordinates of the 3D-model representation of the instrument in respect of both the first series and the second series of 2D-images of the instrument, and to subsequently adapt the 3D-model representation of the instrument in order to optimize the matching of said first series and second series of images of the instrument with 2D-model  
20 images of the instrument derived from said 3D-model representation, and to merge thereafter the adapted 3D-model representation of the instrument with the 3D anatomical structure.

13. Data carrier carrying software for a computer in an apparatus for navigating an instrument through an anatomical structure of a patient's body volume, which is arranged to  
25 implement the steps of:

- acquiring 3D-images of the patient's anatomical structure
- acquiring a first series of 2D-images of the instrument whilst manoeuvring through the anatomical structure, wherein execution of the software causes the computer to
- process the 2D-images of the instrument and the 3D-images of the anatomical structure for  
30 providing merged 3D-images of the instrument manoeuvring through the anatomical structure characterized in that, executing said software causes the computer to register the 2D-images of the instrument with the 3D-images of the anatomical structure prior to providing the merged 3D-images of the instrument and the anatomical structure.